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Metal-Containing Organic and Carbon Aerogels for Hydrogen Storage

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Overview. This document and the accompanying manuscript summarize the technical accomplishments of our one-year LDRD-ER effort. Hydrogen storage and hydrogen fuel cells are important components of the 2003 Hydrogen Fuel Initiative focused on the reduction of America's dependence on oil. To compete with oil as an energy source, however, one must be able to transport and utilize hydrogen at or above the target set by DOE (6 wt.% H_2) for the transportation sector. Other than liquid hydrogen, current technology falls well short of this DOE target. As a result, a variety of materials have recently been investigated to address this issue. Carbon nanostructures have received significant attention as hydrogen storage materials due to their low molecular weight, tunable microporosity and high specific surface areas. For example, the National Renewable Energy Laboratory (NREL) achieved 5 to 10 wt.% H_2 storage using metal-doped carbon nanotubes. That study showed that the intimate mix of metal nanoparticles with graphitic carbon resulted in the unanticipated hydrogen adsorption at near ambient conditions. The focus of our LDRD effort was the investigation of metal-doped carbon aerogels (MDCAs) as hydrogen storage materials. In addition to their low mass densities, continuous porosities and high surface areas, these materials are promising candidates for hydrogen storage because MDCAs contain a nanometric mix of metal nanoparticles and graphitic nanostructures. For FY04, our goals were to: (1) prepare a variety of metal-doped CAs (where the metal is cobalt, nickel or iron) at different densities and carbonization temperatures, (2) characterize the microstructure of these materials and (3) initiate hydrogen adsorption/desorption studies to determine H_2 storage properties of these materials. Since the start of this effort, we have successfully prepared and characterized Ni- and Co-doped carbon aerogels at different densities and carbonization temperatures. The bulk of this work is described in the attached manuscript entitled "Formation of Carbon Nanostructures in Cobalt- and Nickel-Doped Carbon Aerogels". This one-year effort has lead to our incorporation into the DOE Carbon-based Hydrogen Storage Center of Excellence at NREL, with funding from DOE's Energy Efficiency and Renewable Energy (EERE) Program starting in FY05.

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